Developing and Evaluating

A

Simplified Braille Writing Device

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Introduction

This paper deals with the development and testing of a portable pocket braille writing slate for use in communicating with blind persons. It differs from the conventional braille writing device in that it permits writing from left to right as is standard in handwriting, typing, and use of the Perkin's Braille Writer.

In braille writing, the alphabet is rendered into braille by embossing dots on a sheet of paper so that they can be sensed by the fingertips. The standard cell, which can be used to produce any letter or number, consists of six dots arranged in two vertical columns, each having three dots (see Fig. 1). All the letters of the alphabet, and all the numbers from zero through nine, are rendered in braille by various combinations of these six dots.

The conventional slate now in use for writing braille characters is composed of two metal plates, each measuring about 8-1/2" x 1-3/4". The bottom plate contains rounded depressions grouped into braille cells. There are four rows of 27 or 28 cells in each row. The top plate of the slate is provided with guides indicating the positioning of the characters to be written in each cell. The two plates are hinged on one end.

The stylus consists of a metal rod, 1/32" in diameter, mounted in a wooden handle similar to an awl (see Fig. 3a). The rounded handle is cupped in the palm of the hand holding the rod in an upright position. The point of the stylus is rounded to fit the rounded depressions on the bottom

Fig. 1 The Braille Cell

plate of the slate. The stylus, or punch, is used to press the paper into the depressions to form embossed dots in the pattern of braille characters. A piece of heavy paper is inserted between the plates and held by pins on four corners of the lower plate.

The conventional slate forms the dots on the opposite side of the paper. The raised dots or projections appearing on the front side of the paper are made by the use of the rounded stylus by which the paper is pressed down and forced into the concave metal grooves directly beneath on the bottom plate of the slate (see Fig. 3a). In this manner, the letter impressions must be written in reverse. After the impressions have been made, the paper is removed from the slate and turned face up in order that the raised dots can be felt by the fingertips of the reader. It is evident in such a technique for writing, that the various dot combinations which form the letters must be known in reverse. It is necessary to write from right to left instead of left to right and to form each character completely in reverse (see Fig. 2). When teaching a blind person to use the conventional slate, he is told that the numbering of the dot positions is reversed, that is, that on the slate the dots are numbered, one, two, three, downward on the right, four, five, six, downward on the left. As the learning process proceeds the consciousness of the dot position numbers should gradually disappear. The problem is that the newly blinded person may never reach the stage where writing becomes more automatic and less conscious.

The simplified slate was developed to eliminate the reversal of the letter impressions when writing. This slate consists of two metal plates. The bottom plate is provided with embossed projections which are grouped into braille cells. Each cell contains six embossed projections. The simplified slate consists of four rows of 27 cells in each of four rows. There are four pins, one in each corner, to hold the paper securely. The top plate of the slate is provided with guides indicating the positioning of the characters to be written in each cell. The two plates are hinged on one end.

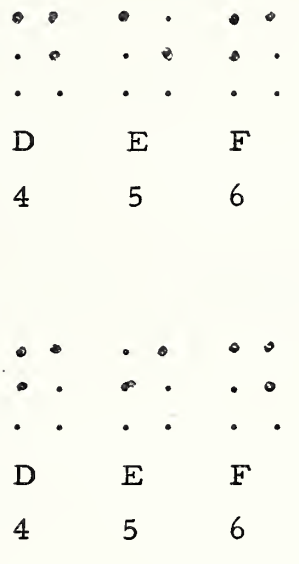

Fig. 2 Example of current practices in teaching the blind reverse impressions which the writer has to produce when writing the characters.

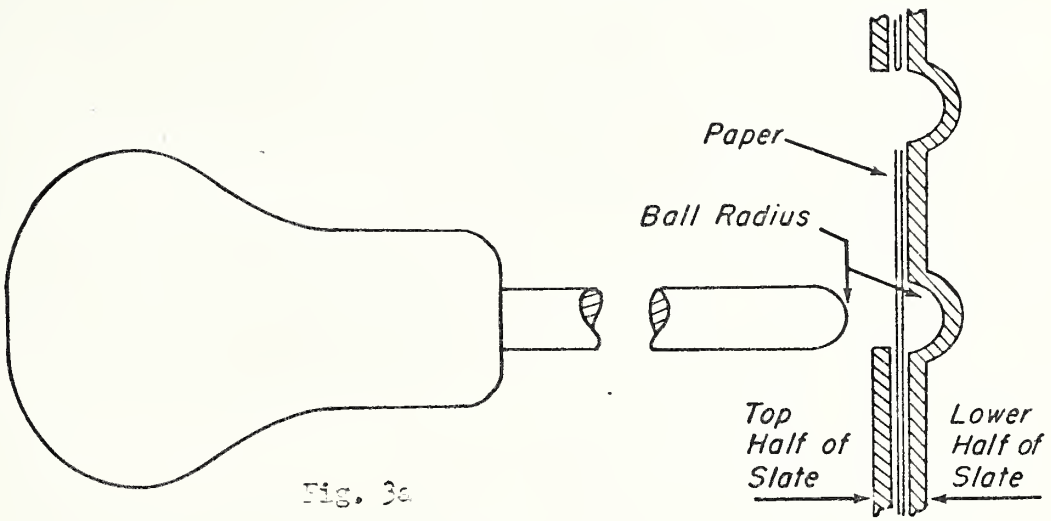

Fig. 3a

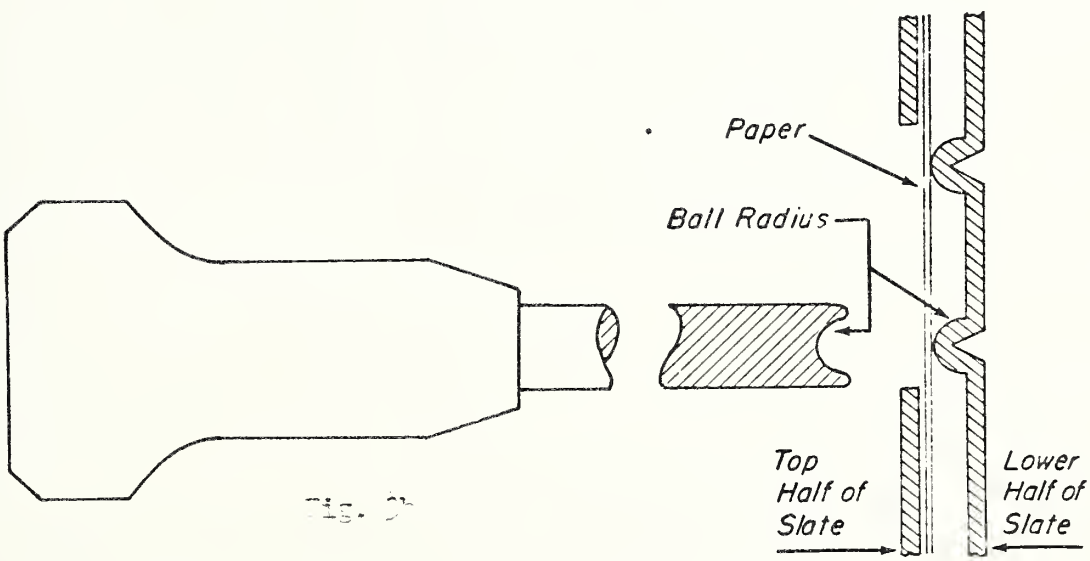

Fig. 3b

Fig. 3 - Conventional Stylus & Stylus - Fig. 3a
Simplified Plate & Stylus - Fig. 3b

The stylus consists of a metal rod 1/16" in diameter, the end of which is hollowed out in a hemispherical shape complimenting the projections on the bottom plate. It is mounted in a wood or plastic handle similar to an awl (see Fig. 3b). The rounded handle is cupped in the palm of the hand, holding the rod in an upright position. The stylus is used to press over the projections to form the embossed dots immediately on the front side of the paper. This is similar to using a cookie cutter in that the impression is made by pressing on top of the projection.

The author worked out this method to overcome the difficulties of the conventional slate by providing a slate which is simple to use because the dots may be formed from left to right in their proper order and arrangement. The dots or characters are written in exactly the same manner in which they are read and the writing of braille is therefore no more difficult than reading braille. The simplified braille slate eliminates the necessity of learning and writing the impressions in reverse because it permits the writing of the words in the order in which they are read. The method also permits the reader to read back or to check over the dots or characters without removing the paper from the slate or reversing the paper, both of which have been necessary with the conventional slate. Reading the impressions can be done immediately by lifting the top plate and running the fingertips over the impressions from left to right. The difficulties encountered in arithmetic or mathematical problems with the conventional slate are eliminated by the simplified slate.

When a grown person is blinded, particularly in middle age or later, the difficulty of learning to read and write braille is greatly increased. The sense of touch is not acutely developed, the fingers are not nearly so sensitive; and the confusion between the totally different braille dot arrangement and the visual appearance of letters with which the blinded person was formerly accustomed makes it difficult for older persons to acquire proficiency in the braille system.

Research Basis for Developing Simplified Slate

Measurements of a standard dot size made by the conventional slate were obtained from the American Printing House For The Blind, Louisville, Kentucky.

A template of four cells was made to produce the best readable dot for the greatest number of blind subjects. Four different shaped dots were used, one shape for each cell. There were no variations with regard to the height of the dots. The variations were in the ball radius. The cells were designated by the letters A B C D. The dot tip radius of A was .022"; B .031"; C .030"; and D .025".

Four corresponding hollowed-out concave shaped styli were designated by the numbers 1, 2, 3, 4. Stylus hollow 1 was .024" ball radius; 2, .033" ball radius; 3, .032" ball radius; and 4, .027" ball radius.

In the experiment, all possible combinations of styli and dots were used simply to check the best readable dot for the greatest number of blind subjects tested (see Fig. 5).

The nine subjects tested were all adults who could read braille. Two were teachers at the Missouri School For The Blind, two were students, four were housewives, and one worked in a medical reference room in a hospital.

The 26 letters of the alphabet were chosen at random in all the combinations for each dot and stylus. Example: cell A with stylus 1, cell A with stylus 2, cell A with stylus 3 etc. (see Fig. 5). A complete set with every combination of cell and stylus consisted of 16 slips of paper, i.e. each subject had 16 slips of paper to read for the test. The tests were given individually. One slip of paper with the brailled letters was placed in front of the subject. The subject was told there would be 15 additional slips handed to him, one at a time. The subject was told the test was for speed and accuracy in reading the brailled letters of the alphabet. The slips of paper were handed to the subject in random fashion.

Cell	A	B	C	D
Stylus 1	1	1	1	1
Stylus 2	2	2	2	2
Stylus 3	3	3	3	3
Stylus 4	4	4	4	4

Fig. 5 - Combinations of Stylus with Cells

He was instructed not to go back over the letters, but to continue to the end of the paper, once the test started. A stop watch was used to indicate the speed at which the subject read each line, and a tape recorder was used to check the accuracy of reading the brailled letters.

A double check test was given to three different teachers and one student. This second test was made with a new group of subjects after the results of the first tests were analyzed for speed and errors. From the results of the first test, the four best combinations of styli and cell and the four poorest combinations of styli and cell were given to four other blind subjects. These eight combinations were used as a validity check on the first test.

The evidence from these tests confirmed the findings that stylus 1 on set D was read with the greatest speed and had the fewest errors. Average speed for set D was 15.9 seconds and average speed on set B was 25 seconds (see Fig. 6). Ten simplified slates were then made using dot D and stylus 1.

A template with cell D and stylus 1 were sent to Nagel and Nax Incorporated, St. Louis, Missouri, a company that has engineering facilities for the production of plastics and rubber. A new vinyl paper was produced for the simplified slate and stylus. It was found that the vinyl, Seilon V.H.I. or P.F.H.I. calandered .005 eliminated the ghost dots and tears when used with the simplified slate and stylus. It was also noted that if the paper was bought in quantity, the cost would not be much more than the braille paper used for the conventional slate. A sample of the vinyl material has been included (see Fig. 7).

The next phase of the project was to test the new simplified slates with a pilot group of youngsters just starting to write braille. This usually starts in third grade. The project continued over a period of six months.

The purpose of the study was to determine whether the present necessity of learning the braille alphabet in reverse and learning to write braille in

Cell	A	B	C	D
Stylus 1		25 sec.		15.9 sec.
Stylus 2		22.6 sec.		16 sec.
Stylus 3		35 sec.		20 sec.
Stylus 4		25 sec.		16 sec.

Fig. 6 Double Check Scores - Average Seconds

tree

light

star

hear

are

beside

beneath

Fig. 7 - Sample of Vinyl Paper
and
Some of the Test Words

reverse could be eliminated by the use of the simplified slate. A second question was whether the simplified slate would prove to be as efficient as the conventional slate.

Dr. Walter E. Evans, Principal of the Missouri School for the Blind, agreed to have the third grade class start on the new simplified slate. The 3rd grade class, the pilot group (PG), had never written braille on the conventional slate before. Their experience with writing braille had only been on the Perkin's Braille Writer.

Mr. William H. Bucklew, Principal of the Ohio State School for the Blind, agreed to give the 3rd and 4th grade classes the tests used in the project. The 4th grade of the Missouri School for the Blind and the 3rd and 4th grades of the Ohio State School for the Blind became the subjects in the control group (CG). These three classes used the conventional slate and stylus and standard braille paper. Many of the subjects in all the groups had other handicaps or disorders besides blindness, such as poor motor coordination and emotional problems (see Fig. 8).

The subjects in the PG started using the simplified slate in September, 1966. The ten simplified slates and styli were kept in the classroom during the testing period from September until February. The subjects practiced only during the period allotted for writing each day. This amounted to about 40 minutes a day. It must be noted, the subjects of the fourth grade classes had been using the conventional slate a year longer than the PG; also, the three classes in the CG had the opportunity to use and practice on the conventional slates at any time. During the months from September, 1966, until February, 1967, the school was visited once a week to get a weekly evaluation from the teacher in charge. Speed and accuracy tests were not given during this time. Good formation of the characters was stressed in order to get the best readability of the dots or characters. Learning how to place the paper in the slate properly, as well as how to hold the stylus in the upright position, were emphasized during these months. At the end of December, 1966, the PG began to work for speed.

SUBJECTS - MISSOURI SCHOOL FOR THE BLIND

Grade 3 - Pilot Group

Age	Number of Subjects	Cause of Blindness
8	1	Congenital Atrophy of Optic Nerve
9	2	Congenital Amaurosis, Post irradiation keratitis secondary to radiation for retina blastoma
10	2	Retrolental Fibroplasia, Primary Optic Atrophy
11	2	Congenital Glaucoma
13	1	Brain Tumor - Meningioma
14	1	Retrolental Fibroplasia
17	1	Retrolental Fibroplasia

Grade 4 - Control Group

10	3	Retrolental Fibroplasia, Optic Atrophy Retinal Degeneration, Congenital Glaucoma
11	1	Retrolental Fibroplasia
12	1	Anophthalmia
13	2	Retrolental Fibroplasia, Microphthalmia

SUBJECTS - OHIO STATE SCHOOL FOR THE BLIND

Grade 3 - Control Group

Age	Number of Subjects	Cause of Blindness
9	2	Retrolental Fibroplasia Cataract, Retinal Detachment
10	1	Cataract
11	5	Glaucoma, Retinal Detachment, Cataract, Optic Atrophy, R.L.F.
12	1	Microphthalamas

Grade 4 - Control Group

11	1	Optic Atrophy
12	1	Cataract
13	3	2 Retrolental Fibroplasia, Cataract
14	2	2 Retrolental Fibroplasia

Fig. 8 - Etiology Data

Tests were set up using words and signs which the subjects learned during the writing periods. The material came from their daily reading and language periods. Each stimulus word in the tests was timed for 3 minutes. Four tests were given: Test 1. Number of rows written, Test 2. Number of words written, Test 3. Test for speed and accuracy (number of words written accurately), and Test 4. Test for speed and accuracy (number of words written accurately). The same tests were given to all the groups. The PG used the simplified slate and the vinyl paper. The CG used the conventional slate and the standard braille paper. The teacher called off each word, one at a time. She asked the subjects to spell the word aloud and to use the braille shorthand symbols whenever possible. The subjects were instructed to write the word repeatedly for three minutes.

In February, 1967, ten additional simplified slates were made incorporating two changes. Sharper posts were made on the bottom plate to prevent the paper from slipping, and more prominent dots were made on the face plate for the division of every five cells. These slates were also made by hand. The experimental subjects were now able to take one slate out of the room for practice purpose. The ten new ones were kept under control by the teacher.

Results

A series of tests were conducted between the CG consisting of 3 classes using the conventional slate, and the PG, using the simplified slate. The purpose of these tests was to find out if there were differences in performance between the experimental and control groups and whether or not the differences were significant (see Fig. 9). Although the differences of performance were not significant, it is interesting to note that the highest individual score for writing some of the words was done by the subjects in the PG. For example, the word "beside" was written 43 times with 2 errors in the PG, compared to 35 times with 6 errors in the CG. When repeating the

Table 1

Comparison of test scores of experimental and control groups with mean performance, t scores, df and level of significance achieved

Conditions - Each stimulus word timed for 3 minutes.
All subjects compared in each condition

		PG	CG	Pertinent to Both
Test 1.	Number of rows written			
	Mean	11.2	8.52	
	t score for significance at .05 level			2.04
	df			31
	t score			1.15
Test 2.	Number of words written			
	Mean	88.1	96.3	
	t score for significance at .05 level			2.04
	df			31
	t score			.24
Test 3.	Number of words minus errors			
	Mean	68.7	72.3	
	t score for significance at .05 level			2.04
	df			31
	t score			.01
Test 1.	Number of rows written	Ohio Grade 3		
	Mean	11.2	9.4	
	t score for significance at .05 level			2.11
	df			17
	t score			.7
		No. Grade 4		
	Mean	11.2	7.7	
	t score for significance at .05 level			2.13
	df			15
	t score			1.4
		Ohio Grade 4		
	Mean	11.2	8.1	
	t score for significance at .05 level			2.13
	df score			15
	t score			.34

Fig. 9 - Comparison of Test Scores

letters of the alphabet in 3 minutes, one of the subjects in the PG wrote 90 letters with only 1 error, compared to 76 letters with 10 errors in the CG. The results show also that all experimental subjects in the PG learned to use the new slate and stylus whereas in the CG 5 out 7 used the conventional slate in one group, 6 out 9 in another, and 4 out 7 in the 3rd group.

Discussion

It was concluded that the simplified slate can be used without any loss of speed and accuracy to the new beginners. It is important to note that the CG was given the standard training in reversing the braille characters before getting to use the conventional slates. The simplified slate eliminates this instruction period. Also, when the CG begins using the conventional slate, the subjects had access to the slate at all times. The fourth grades using the conventional slate had a year's training when the tests began. The PG had access to the simplified slate about 40 minutes a day. The obvious reason for this limitation was that there were only ten slates in existence, all made by hand. Although none of the subjects in the PG complained of fatigue during the writing and testing periods on the simplified slate, it would probably be well to establish that the output of pressure required on the new device would at least be the same, and not greater than the energy required to write braille on the conventional slate. In the past, other upward writing devices have been criticized because of the expenditure of energy in the production of characters (see APH 1960). All that can be reported at this stage in the development of the simplified device is that there was no sign of fatigue either during testing or training. The dots written on the simplified slate are just as clear as those made on the conventional slate. The subjects using the simplified slate and stylus do not tear the paper as much as the subjects using the conventional slates. Ghost dots had been eliminated with the new vinyl paper on the simplified slate.

Summary

Research was done to produce the best readable dot from the greatest number of blind subjects tested. From the research findings ten simplified slates were made. The new simplified slates were then tested with a PG of ten subjects in the 3rd grade. In addition to the multiple handicaps of some of the subjects, there was a wide range in age difference. The subjects were tested over a period of six months. They were not allowed to take the slates from the room, and they practiced about 40 minutes a day. There were no changes made in the ten additional slates other than those mentioned.

General observation has indicated great enthusiasm on the part of the subjects to be able to read immediately what they have written. The new vinyl has indicated the dots will not rub out as readily as standard braille paper. There were no significant differences in performance between the control and pilot groups, but the simplified procedure demonstrates obvious advantages; the elimination of months of instruction in reversing the braille characters; the writing of braille from left to right; the writing of braille characters as they are read instead of having to write them in reverse position; and the reading of what has been written immediately without turning the sheet over. With the conventional slate, the writing must be face down until the page is turned into reading position. The subjects can write braille using the new simplified slate without losing speed or accuracy. The new simplified slate and stylus with the new vinyl paper has proved, for reasons mentioned above, to be superior to the conventional technique for the beginner.

Further research is to be conducted with other groups to gain insight into longitudinal effects of training with the simplified slate for both beginning and advanced students. Other subject matter such as mathematics and music will be investigated.

*Mrs. Ruth L. Barr is Supervisor of the Occupational Therapy Services, Department of Ophthalmology, McMillan Hospital, St. Louis, Missouri. The research herein reported was conducted in partial fulfillment of the Master of Arts Degree, Webster College, St. Louis, Missouri.

**Dr. Carl E. Pitts, Chairman of the Social-Behavioral Science Department, Webster College, St. Louis, Missouri, was the thesis director.

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